AMATEUR SATELLITE REPORT

AMSAT's Newsletter for the Amateur Space Program.

Amateur Satellite Report is endorsed by the American Radio Relay League as the special interest Newsletter serving the Amateur Radio Satellite Community

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Short Bursts

•The Mode J balloon experiment of South African amateurs will now occur on 26 Feb. 82 at about 0600 UTC. The idea is to carry a Mode J transponder aloft in a balloon. Estimated maximum altitude could be as high as 440,000 feet. The transponder would then have a several hundred mile range. Command links will be on 2 meters and 70 cm. Dave Woodall, ZS6BNT is Project Manager. Launch will be from Tranvaal Province. Telemetry may be relayed on 14.270 MHz. Tks ZS1FE, ZS1KE, ZS1BI, ZS6AKV.

•Soviet DXpedition to 4K1 going OK despite blown power amp. Watch for 4K1CR, 4K1KD and 4K1QCG. They're on RS-6, 8.

•GB2RS, the call of the RSGB, has been approved for use by the British entry to the Phase IIIB Bulletin team. AMSAT UK Secretary G3AAJ is Liaison to RSGB on this activity. W1AW is U.S. participant. Bulletin stations will provide key information in many languages. Contact K1HTV or G3AAJ for info.

•Penrin in the Cook Islands is on Mode A according to W6CG. Watch for ZK1WL.

•AMSAT stalwarts show up in February *QST*: Senior Vice President K8OCL has FB article on Solar Sail project (page 57). Regular columnist W3XO (The World Above 50 MHz) has devoted his February *QST* column to Phase III. (page 80). Good reading...both!

•ACTIVE satellite DX: 9H1O, TU2IE, TU2IT, EL3DJ, UAØBBN.

•Phase IIIB now scheduled for 27 May 83 according to unofficial sources.

•John Earhart, W8SMC, of Cincinatti is a silent key. An active satellite amateur, John often helped out at the AMSAT booth at the Dayton Hamvention.

•VE2END is starting a new AMSAT Net in Quebec Province, Canada. Specifics: 3780 kHz on Friday evenings at about 0130 UTC after Quebec Net. This net will be au Francais.

•W5LFL/Shuttle hamming flight proposal still undecided. NASA working on the proposal from ARRL/AMSAT. Odds right now look 60-40 in favor but recent problems with hydrogen leaks on Challenger may delay everything...put more plans in jeopardy.

•No word yet on the ARNET (Cablesat General) proposal for two amateur geo-syncs yet either.

•RS-1 and RS-2 signal now being heard by many. Reference orbits for RS-1 for 31 Jan. 83: #18634, 01:16 @ 146.4. Period 120.3842 minutes, increment 30.2260 degrees. inclination 82.55 degrees, height 1695 km. For RS-2, reference orbit for 31 Jan. 83: #18630, 01:35 @ 151.8 degrees. Period 120.4118, increment 30.2327, inclination 82.55, height 1697 km. Thanks PAØDLO; B. Lindholm.

•*Orbit* #12 goes in mail first week in February. Feature articles by N5AHD, N1DM, WH6AMX and W2RS. Regular columns by W6SP, G3IOR, K2ZRO, Falworth. Allow 2-3 weeks for mailing. Meanwhile, be sure to get your renewals in soon!

•W1BIH continues to operate Mode A from PJ2. Will be there until April.

•DL7AD has been operating from EA8 on Mode A.

•*ASR* celebrates its Second Anniversary this February. Three cheers!

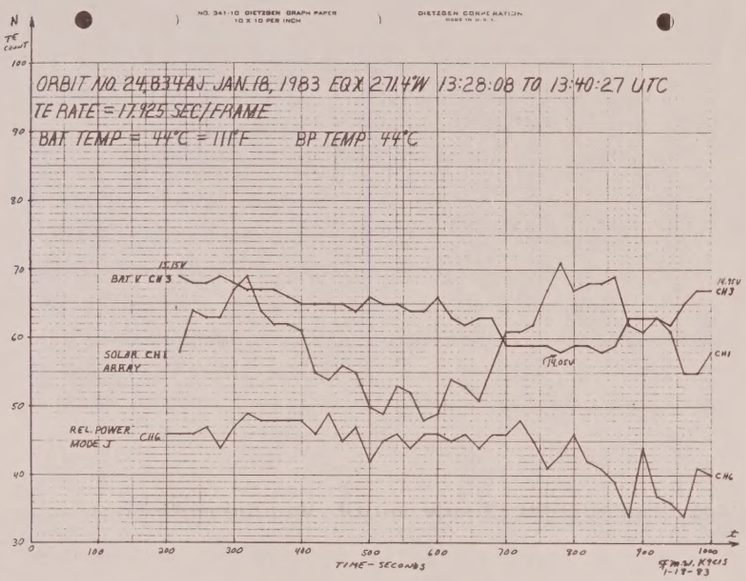
•AMSAT "Trinkets and Goodies" catalog under study. What goodies would YOU like to see in it? Already tapped are callsign badges, tie tacks, QSL cards, decals, desk sets, T-shirts and sew-on patches. Ball caps are being considered.

AO-8 Battery Condition Watched

According to veteran satellite telemetry logger K9CIS, one cell in AO-8's battery appears to go to zero charge after about 12 hours of dual AJ mode. Frank has been plotting graphs of the battery voltage (channel 3), solar array current (channel 1) and Mode J relative power (channel 6) and finds some disturbing patterns. The accompanying graph supplied by K9CIS illustrates what Frank sees as a growing weakness in one of the cells. "Looks like things are changing faster than I expected," says Frank in comparing similar plots he forwarded to *ASR* last autumn with the most recent one made on orbit 24,834 (Mode AJ), 18 Jan. 83. "Looks to me like after about 12 hours of AJ, one cell goes down to zero charge and stays that way the second half of the 24 hour period. Not so good for the weak cell."

AMSAT-OSCAR 8 was launched 5 Mar. 78. The nearly 5-year old bird's battery bears watching according to K9CIS. According to W9KDR and W3HV, the telemetry

on AO-8 is carefully monitored and battery conditioning is carefully planned to avoid undue stress on the cells. Nevertheless, the batteries on AO-8 are clearly past their prime if the telemetry is to be believed according to K9CIS.


ORBIT NO 24834A JAN 18, 1983 EQX 271.4°W 13:28:08 TO 13:40:27 UTC
TE RATE = 17.925 SEC/FRAME
BAT TEMP = 44°C = 111°F BP TEMP 44°C
BAT V CH3
SOLAR CH1 ARRAY
REL POWER MODE J CH6
CH3
CH1
CH6
TIME - SECONDS

QSL Bureau Notes

As announced in *ASR* #48/49, the AMSAT QSL Bureau is now operating under the management of WB8OTH, Perry, at 1850 Lisle Avenue, Obetz, OH 43207. Due to an oversight, a recent press release incorrectly stated that WB2LCC continues to be the QSL Bureau manager. This is not correct. AMSAT regrets the error and any ensuing confusion. Please mail your envelopes to the new Bureau at the address above in Ohio.

UO-9 Progress Report

UoSAT's progress continues to be expressed in fits and starts. Such is the nature of exploring the unknown. Recently, however, several promising signs have been evident as the accompanying UoSAT Bulletin #13 bears witness.

Copied from the spacecraft's 1200 baud 2 meter beacon (145.825 MHz NBFM) by KA9Q, the copy was relayed to *ASR* by electronic mail and printed at WA2LQQ as you see it. (This is not manifestly different from how a satellite store and forward packet satellite, e.g., PACSAT, might function.)

Notable in this bulletin are assertions that both the UHF (2.4 GHz) and SHF (10.5 GHz) beacons have been tested and have proven operable as evidenced by the telemetry channels 12 (2.4 GHz power output); 24 (10.4 GHz current); 34 (2.4 GHz current). G3YJO indicates that the S-band beacon (2.4 GHZ) may be sought by the ground station at Surrey prior to final attitude adjustment as schedule allows.

The schedule now calls for the first stages of boom deployment on orbit 7316 which occurs 1 Feb. 82. As you read this the boom deployment may already have been accomplished. Watch telemetry status point 29. A "1" here indicates the tip mass has been uncaged. Status point 45 at a "1" would indicate the boom motor is armed and status point 41 at "0" would indicate boom deployment in the forward (extension) position. Finally, watch status point 32. If that goes to "1", you'll know boom deployment is in progress; that's the motor power. Chances are, though, that only those in Europe will view the boom deployment session.

UOSAT SPACECRAFT CONTROL CENTRE
UNIVERSITY OF SURREY, GUILDFORD, SURREY, ENGLAND
****

UOSAT SPACECRAFT OPERATIONAL STATUS:
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**** UOSAT BULLETIN-13 1200 GMT 28 JANUARY 1983 ****

** S/C NEWS **

THE 2.4 GHZ AND 10.5 GHZ BEACONS ON UOSAT WERE ACTIVATED ON ORBITS 6920 AND 6996 WHEN TELEMETRY INDICATED BOTH BEACONS TO BE OPERATING CORRECTLY WITH 100 MW OUTPUT ON 2.4 GHZ. ATTEMPTS TO TRACK THE 2.4 GHZ BEACON BEFORE STABILISATION IS COMPLETE MAY FOLLOW IF THE ATTITUDE MANOEUVRES SCHEDULE ALLOWS.

THERE HAVE BEEN FURTHER TESTS ON THE CCD EXPT IN PREPARATION FOR POST-STABILISATION OPERATIONS. CCD EXPT OPERATION WAS NOMINAL AND RESULTS WILL BE GIVEN WHEN ANALYSIS IS COMPLETE.

A COMPLETE LIST OF TELEMETRY CALIBRATION EQUATIONS, INCLUDING UPDATES, WILL BE INCLUDED IN A BULLETIN SOON.....WATCH THIS SPACE!

** S/C ATTITUDE **

FURTHER ATTITUDE MANOEUVRES TO TILT THE S/C UP INTO THE ORBIT PLANE IN PREPARATION FOR BOOM DEPLOYMENT HAVE CONTINUED THIS WEEK, INCLUDING CHANGES TO THE Z-SPIN PERIOD, CURRENTLY 50 SECS AT 47 DEGREES. WE HOPE TO BE THERE SOON!!

** S/C OPERATIONS SCHEDULE **

MONDAY TO FRIDAY.....ATTITUDE CONTROL & SYSTEM TESTS (INC CCD)

SATURDAY & SUNDAY.....TELEMETRY, BULLETIN & SPEECH TELEMETRY

********** THE 145 MHZ BEACON WILL BE OFF FROM 1200 GMT SUNDAY 30/1/83 FOR ESSENTIAL ATTITUDE MANOEUVRES USING 435 MHZ BEACON **********

IF ALL GOES WELL, THE TIP-MASS RELEASE PYROS ARE SCHEDULED TO BE FIRED ON ORBIT 7316 FOLLOWED BY RECALIBRATION OF THE MAGNETOMETERS.

** THANKS FOR FEEDBACK **

G3LYP, G8UYB, HP1AC, G8EDG, K4GFG, DB2OS, G3YMC, WD4IXI, JH7CKF, AMSAT-UK-523, AMSAT-LM-728, SM7AID, HP1AC, WA5ZIB, G3UYB, G4ROA, SM7-6859, JA4GVA, OZ1WN.

POST BOX

*** JR1SWB DE G3YJO, TNX FOR LETTER 11/1/83 WILL ADVISE WHEN VISIT POSSIBLE.

*** QSL CARDS WILL BE SENT TO ALL STATIONS SUPPLYING REPORTS SHORTLY.

SPACECRAFT ORBITAL DATA

ORBITS FOR 28TH JANUARY

	UOSAT	OSCAR-8	NOAA-7	
ORBIT NO :	7256	24975	8247	
EQX TIME :	15:19:41	15:18:58	14:31:53	GMT
EQX LONG :	2.8	307.7	351.8	DEG.W
MEAN HGT :	509.0	905.0	850.0	KM
PERIOD :	94.7662145	103.1680733	101.9167240	MINS
P-DRAG :	7.191E-05	2.611E-06	8.000E-06	*N-REF
LONG INC :	23.6911583	25.7934846	25.4735060	DEGS
L-DRAG :	1.809E-05	7.028E-07	2.000E-06	*N-REF

QSL/POST CARDS CONFIRMING RECEPTION OF UOSAT DATA INCLUDING STATION DETAILS WOULD BE APPRECIATED FOR SURVEY OF NO. AND GEOGRAPHIC DISTRIBUTION OF ACTIVE STATIONS
SEND TO: DR.M.N.SWEETING, UOSAT CONTROL CENTRE - THANK YOU

Area Coordinator Appointments

AMSAT Chief Area Coordinator (U.S./Canada) WØCY has announced the following Area Coordinator appointments effective immediately.

Richard F. Bishop, K4SR, Assistant Area Coordinator, Virginia

Al Brinkerhoff, WB5PMR, Area Coordinator, North Texas (replaces KO5I who recently was elected Assistant Vice President for Operations).

Darrell Crimmins, KG5E, Assistant Area Coordinator, Texas.

Bob Stricklin, N5BRG, Assistant Area Coordinator, Texas.

Craig Martin, WAØWPJ, Assistant Area Coordinator, Missouri.

ASR congratulates the new appointees!

Project OSCAR Calendar Corrections

The Project OSCAR calendar of orbits is now about 90 days old. That is, the predictions were made in November and published in December. Project OSCAR President W6XN now indicates that in some cases there is sufficient difference in the EQX times to warrant noting the correction factors. Here they are: (In each case add the following time in seconds to the satellite indicated)

AO-8, +90.6; RS-5, +13.8; RS-6, −27; RS-7, −22.6; RS-8, +23.6

According to W6XN, "No corrections are necessary for the longitude of equatorial crossing. The predictions were made on day 315. The only clear trend is for AO-8 where it appears that the rate of change predicted for the period is slightly greater than reality. The correction for AO-8 will continue to increase with time unless some large increase in solar activity is realized. The corrections for the RS satellites will probably oscillate about zero through the year."

The Project OSCAR Calendar lists every orbit of 1983 for AO-8 and RS-5, 6, 7 and 8. RS-3, 4 and UO-9 are not covered. The calendar may be obtained for $10 postpaid to U.S., Canada and Mexico. Mail to Project OSCAR, P.O. Box 1136, Los Altos, CA 94022. Please include a self-addressed mailing label with your order. Allow 3-4 weeks for delivery.

Air Force Nixes "C" Ride

AMSAT has been notified by U.S. Air Force officials in Washington that AMSAT's proposal to fly its Phase IIIC satellite aboard a USAF mission together with a DSCS satellite has be disapproved.

The letter to AMSAT's Silver Spring office stated that although the proposal appeared technically feasible, the added cost of integration, estimated at $1.8 million, could not be programmed by USAF.

This unfortunate development has left AMSAT looking for a ride for its follow-on Phase III mission. Earlier discussions had centered on getting aboard a DSCS (Defense Satellite Communications System) launch and boosting a so-called geo-synchronous drifter orbit. Mission changes for the DSCS program eliminated that possibility. More recently W3GEY had developed a comprehensive proposal which was submitted by AMSAT to USAF 28 Oct. 82.

According to AMSAT President Dr. Tom Clark, W3IWI, while the negative response was obviously a disappointment, "We'll certainly go back to the drawing boards to find another launch opportunity. It just means we have to beat the bushes a little harder and a little longer. Something will show up."

Geostationary Reflector Boosted As Sat-comm Alternative

As envisioned by its designer, a lightweight wire mesh satellite, supported in low orbit by a powerful ground-based microwave beam, will someday reflect radio communication signals distances up to 1000 miles. According to a report in *Electronic Engineering Times* (Jan. 3, 1983), the so-called "Space Mirror" will measure approximately 30 feet across yet will weigh less than 0.1 g. Wires in the parabolic mesh will be just a few hundred angstroms thick.

Inventor Paul Csonka and the company holding patent rights to the device—Electronics, Missiles & Communications, Inc. of White Haven, Pennsylvania—see the passive satellite as a low-cost alternative to complex active satellites. Because of attenuation in the atmosphere, Csonka feels that a ground-based transmitter may have to supply as much as 60 kW of rf in order to maintain the satellite in a fixed position above the earth at altitudes between 65 and 125 miles.

SARSAT Spoofed Says Steamboat Springs Sheriff

SARSAT is a Search and Rescue Satellite system operated jointly by several nations including the Soviet Union, Canada and the U.S. (See *ASR* #43/44). Using SARSAT satellites rescuers can locate downed aircraft by analyzing the Doppler shift of the vhf beacon. The Emergency Locator Transmitter (ELT) on aircraft is automatically set off after a crash. The satellite monitors the ELT frequency and relays the signal, together with the inherent Doppler shift caused by the satellite's movement across the crash site, to listeners at rescue bases around the world. That's how it's supposed to work.

Recently, however, Sheriffs officers near Steamboat Springs, Colorado were alerted by officials at Scott Air Force Base, Illinois, that a SARSAT was picking up signals from an activated ELT. The analysis indicated the downed aircraft was some eight miles from the Steamboat Springs airport.

However, just as rescue aircraft were about to sortie from Denver, a group with an ELT receiver on the ground located the signal source. The ELT signal was coming from the locked office of a travel agent! No aircraft in sight. An ELT on a workbench in the office belonging to the owner, himself a pilot, had been accidentally tripped off. The circling SARSAT, some 600 miles up did its duty, travel office or nought!

ORBITAL INFORMATION

(Thanks KA9Q)

OSCAR-8:
Wed Jan 26 01:25:23 1983 UTC: Ascending node at 100.582 west
Nodal period: 103.16911 min
Longitude increment: 25.794574 deg w/orbit
Element set #724
Element set epoch: Tue Jan 18 12:52:38 1983 UTC

OSCAR-9:
Wed Jan 26 00:08:57 1983 UTC: Ascending node at 134.977 west
Wed Jan 26 01:43:43 1983 UTC: Ascending node at 158.668 west
Nodal period: 94.76881 min
Longitude increment: 23.691313 deg w/orbit
Element set #391
Element set epoch: Thu Jan 20 08:18:34 1983 UTC

RS-3:
Wed Jan 26 01:14:50 1983 UTC: Ascending node at 88.651 west
Nodal period: 118.51867 min
Longitude increment: 29.756458 deg w/orbit
Element set #47
Element set epoch: Tue Jan 18 11:31:08 1983 UTC

RS-4:
Wed Jan 26 01:21:04 1983 UTC: Ascending node at 86.353 west
Nodal period: 119.39409 min
Longitude increment: 29.975570 deg w/orbit
Element set #80
Element set epoch: Tue Jan 18 12:16:11 1983 UTC

RS-5:
Wed Jan 26 00:26:12 1983 UTC: Ascending node at 71.914 west
Wed Jan 26 02:25:45 1983 UTC: Ascending node at 101.930 west
Nodal period: 119.55500 min
Longitude increment: 30.015748 deg w/orbit
Element set #67
Element set epoch: Thu Jan 20 00:58:14 1983 UTC

RS-6:
Wed Jan 26 01:38:18 1983 UTC: Ascending node at 93.665 west
Nodal period: 118.71619 min
Longitude increment: 29.805877 deg w/orbit
Element set #44
Element set epoch: Wed Jan 12 13:08:50 1983 UTC

RS-7:
Wed Jan 26 01:05:40 1983 UTC: Ascending node at 83.414 west
Nodal period: 119.19495
Longitude increment: 29.925660 deg w/orbit
Element set #84
Element set epoch: Mon Jan 17 04:31:48 1983 UTC

RS-8:
Wed Jan 26 01:30:18 1983 UTC: Ascending node at 87.189 west
Nodal period: 119.76366 min
Longitude increment: 30.068025 deg w/orbit
Element set #182
Element set epoch: Mon Jan 17 11:54:37 1983 UTC

```
Satellite: noaa-6
Catalog number: 11416
Epoch time:      83012.51057488
                 Wed Jan 12 12:15:14 1983 UTC
Element set:          400
Inclination:       98.6091 deg
RA of node:        44.7136 deg
Eccentricity:     0.0012406
Arg of perigee:   124.0153 deg
Mean anomaly:     236.2209 deg
Mean motion:   14.24462271 rev/day
Decay rate:     4.27e-06 rev/day/day
Epoch rev:           18356
Semi major axis:  7189.869 km
Anom period:    101.090779 min
Apogee:           835.007 km
Perigee:          817.168 km
```

```
Satellite: noaa-7
Catalog number: 12553
Epoch time:      83016.22867974
                 Sun Jan 16 05:29:18 1983 UTC
Element set:          179
Inclination:       98.9756 deg
RA of node:       339.2169 deg
Eccentricity:     0.0013662
Arg of perigee:   114.5090 deg
Mean anomaly:     245.7510 deg
Mean motion:   14.12822819 rev/day
Decay rate:      3.68e-06 rev/day/day
Epoch rev:           8071
Semi major axis:  7229.279 km
Anom period:    101.923609 min
Apogee:           878.285 km
Perigee:          858.532 km
```

```
Satellite: oscar-7
Catalog number: 7530
Epoch time:      82334.40718817
                 Tue Nov 30 09:46:21 1982 UTC
Element set:          478
Inclination:      101.3994 deg
RA of node:       336.3150 deg
Eccentricity:     0.0011748
Arg of perigee:   269.7184 deg
Mean anomaly:      90.2542 deg
Mean motion:   12.53379655 rev/day
Decay rate:       -2e-08 rev/day/day
Epoch rev:           36792
Semi major axis:  7829.772 km
Anom period:    114.889371 min
Apogee:          1481.375 km
Perigee:         1462.978 km
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```
Satellite: oscar-8
Catalog number: 10703
Epoch time:      83018.53655690
                 Tue Jan 18 12:52:39 1983 UTC
Element set:          724
Inclination:       98.7659 deg
RA of node:        38.3772 deg
Eccentricity:     0.0007248
Arg of perigee:    25.5733 deg
Mean anomaly:     334.5748 deg
Mean motion:   13.96533406 rev/day
Decay rate:      1.9e-07 rev/day/day
Epoch rev:           24835
Semi major axis:  7285.370 km
Anom period:    103.112464 min
Apogee:           916.397 km
Perigee:          905.836 km
```

```
Satellite: oscar-9
Catalog number: 12888
Epoch time:      83020.34622885
                 Thu Jan 20 08:18:34 1983 UTC
Element set:          391
Inclination:       97.5262 deg
RA of node:       346.3386 deg
Eccentricity:     0.0004124
Arg of perigee:    96.7246 deg
Mean anomaly:     263.4439 deg
Mean motion:   15.20356357 rev/day
Decay rate:     8.505e-05 rev/day/day
Epoch rev:            7132
Semi major axis:  6884.420 km
Anom period:     94.714637 min
Apogee:           529.845 km
Perigee:          524.167 km
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```
Satellite: rs-3
Catalog number: 12997
Epoch time:      83018.47995425
                 Tue Jan 18 11:31:08 1983 UTC
Element set:           47
Inclination:       82.9597 deg
RA of node:        59.0376 deg
Eccentricity:     0.0058681
Arg of perigee:   348.7727 deg
Mean anomaly:      11.2024 deg
Mean motion:   12.15573847 rev/day
Decay rate:         4e-08 rev/day/day
Epoch rev:            4824
Semi major axis:  7991.334 km
Anom period:    118.462568 min
Apogee:          1660.882 km
Perigee:         1567.094 km
```

```
Satellite: rs-4
Catalog number: 13000
Epoch time:      83018.51124947
                 Tue Jan 18 12:16:12 1983 UTC
Element set:           80
Inclination:       82.9432 deg
RA of node:        62.8190 deg
Eccentricity:     0.0019604
Arg of perigee:    49.3274 deg
Mean anomaly:     310.9483 deg
Mean motion:   12.06657577 rev/day
Decay rate:      1.12e-06 rev/day/day
Epoch rev:            4789
Semi major axis:  8030.639 km
Anom period:    119.337916 min
Apogee:          1680.354 km
Perigee:         1648.867 km
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```
Satellite: rs-5
Catalog number: 12999
Epoch time:      83020.04044557
                 Thu Jan 20 00:58:14 1983 UTC
Element set:           67
Inclination:       82.9551 deg
RA of node:        62.6307 deg
Eccentricity:     0.0011437
Arg of perigee:    80.6517 deg
Mean anomaly:     279.5817 deg
Mean motion:   12.05035698 rev/day
Decay rate:      1.1e-07 rev/day/day
Epoch rev:            4801
Semi major axis:  8037.841 km
Anom period:    119.498535 min
Apogee:          1689.397 km
Perigee:         1671.011 km
```

```
Satellite: rs-6
Catalog number: 13002
Epoch time:      83012.54781228
                 Wed Jan 12 13:08:51 1983 UTC
Element set:           44
Inclination:       82.9589 deg
RA of node:        63.1762 deg
Eccentricity:     0.0050345
Arg of perigee:    15.7578 deg
Mean anomaly:     344.5040 deg
Mean motion:   12.13550353 rev/day
Decay rate:         4e-08 rev/day/day
Epoch rev:            4744
Semi major axis:  8000.212 km
Anom period:    118.660095 min
Apogee:          1663.898 km
Perigee:         1583.344 km
```

```
Satellite: rs-7
Catalog number: 13001
Epoch time:      83017.18875318
                 Mon Jan 17 04:31:48 1983 UTC
Element set:           84
Inclination:       82.9568 deg
RA of node:        62.6246 deg
Eccentricity:     0.0023016
Arg of perigee:    19.0119 deg
Mean anomaly:     341.1771 deg
Mean motion:   12.08674395 rev/day
Decay rate:       9.2e-07 rev/day/day
Epoch rev:            4781
Semi major axis:  8021.707 km
Anom period:    119.138786 min
Apogee:          1664.260 km
Perigee:         1627.334 km
```

```
Satellite: rs-8
Catalog number: 12998
Epoch time:      83017.49627124
                 Mon Jan 17 11:54:38 1983 UTC
Element set:          182
Inclination:       82.9438 deg
RA of node:        64.8225 deg
Eccentricity:     0.0018182
Arg of perigee:   120.6695 deg
Mean anomaly:     239.6156 deg
Mean motion:   12.02932239 rev/day
Decay rate:      2.01e-06 rev/day/day
Epoch rev:            4762
Semi major axis:  8047.205 km
Anom period:    119.707491 min
Apogee:          1699.274 km
Perigee:         1670.011 km
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